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The Pauropoda and Symphyla of the Geneva Museum III. On the identification of immature stages in *Gravieripus cordatus* Scheller (Myriapoda, Pauropoda, Eurypauropodidae)

by

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With 5 figures

ABSTRACT

The chaetotaxy of the pygidial tergum in the post-embryonic stages of the Eurypauropodidae species *Gravieripus cordatus* is described. The first, second and fourth instar larvae are mutually similar and strongly diverging from the third instar larva and the adult. This is without parallel in the Pauropoda and shows that the supposed high stability of the pygidial characters during the post-embryonic development is less than has been regard earlier, at least in Eurypauropodidae.

1. INTRODUCTION

Earlier investigations on the Pauropoda were most often based on studies on adult specimens because manual collecting was the only method available before Berlese, in 1905, developed the funnel extraction method. In collecting by hand the larger, that is also the adult, specimens are overrepresented because immature forms often are very small. So is the first instar larva generally shorter than 0.2-0.3 mm. Almost all formal identification by earlier authors was restricted to adult specimens.

Now much of the soil and litter fauna can be, and often is, extracted by means of funnel and flotation methods. They often are exceedingly effective also extracting immature forms so the study of modern collections requires a familiarity with the appearance of the various larval stages. In general this is not any serious problem in the Pauropoda because the immature stages from the first instar larva to the subadult inclusive present the main characters of the adult animal. Particularly with respect to the pygidium which has so many species-separating characters the resemblances are so great and the intraspecific variation so slight that it has been considered possible to erect new species on immature specimens. A few have also been described.

However, a close study of the various developmental stages of the Eurypauropodidae species *Gravieripus cordatus* Scheller has shown that future descriptions of new species on immature specimens have to be prepared with cautiousness, at least in the mentioned family.

2. MATERIAL

Dr. Bernd Hauser at the Natural History Museum, Geneva, collected 44 specimens of the Eurypauropodidae species *Gravieripus cordatus* Scheller from two localities in Greece. The species was previously known from two localities only, one in Spain (6 ad. 9 [1], 1 subad. 8) and the other (2 ad. 9) in Turkey (Scheller 1974: 622).

The Greek material consists of 35 specimens (16 ad. 9, all females, 5 subad. 8, all females, 2 juv. 6, 8 juv. 5, 4 juv. 3) collected 1972-04-19 on Ithaca, near Exoghi (Loc. Io-72/57) and 9 (3 ad. 9, all females, 1 subad. 8, female, 3 juv. 6, 2 juv. 5) collected 1973-04-26 on Rhodes, Petaloudes (Loc. Rh-73/8), in all 44 specimens representing all the developmental stages from the first instar larva (juv. 3) to the subadult (subad. 8) and adult stages (See also Scheller 1977).

3. EXTERNAL PYGIDIAL CHARACTERS

The following is not an exhaustive description of the development of the whole pygidium but is restricted to the stages of the tergum, particularly its chaetotaxy. The styli are similar in all the juvenile and adult stages and are not described.

3.1 First instar larva (fig. 1)

It has 3 pairs of legs, 3 tergites and 2 pairs of tactile setae; length 0.29-0.34 mm, breadth 0.22-0.25 mm.

Pygidial tergum. Posterior margin rounded but with a low and broad posteromedian lobe between the styli. There are 6 pairs of setae: not only the *st*, a_1, a_2 and a_3 but also two pairs, d_1 and d_2, on the anterolateral part. Relative length of setae: $a_1 = 10$, $a_2 = 10\text{-}13$, $a_3 = 24\text{-}32$, $d_1 = 10$, $d_2 = 32\text{-}35$.

The a_1, a_2 and d_2 are glabrous and winged, forming heart-shaped shields projecting posteriorly from the hind-part of flat-bottomed and shallow depressions of the cuticle. The a_3 and d_2 are glabrous, spinous, straight, diverging. Distance a_1-a_1 1.1-1.4 times as long as a_1, distance a_1-a_2 1.5-1.6 times as long as distance a_2-a_3. The a_1, a_2 and d_1 are inserted on the hindmost part of the dorsal side of the tergum, a_2 and d_2 on its posterior margin.

3.2 Second instar larva (fig. 2)

It has 5 pairs of legs, 4 tergites and 3 pairs of tactile setae; length 0.37-0.49 mm, breadth 0.27-0.29 mm.

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[1] Abbreviations: ad. ..., subad. ... and juv. ..., an adult, a subadult or a juvenile specimen with the number of pairs of legs indicated.

Pygidial tergum. Posterior margin as in first instar larva. There are 5 pairs of setae: *st*, a_1, a_2, a_3 and d_2. No d_1. Relative length of setae: $a_1 = 10$, $a_2 = 10\text{-}13$, $a_3 = 18\text{-}26$, $d_2 = 15\text{-}23$.

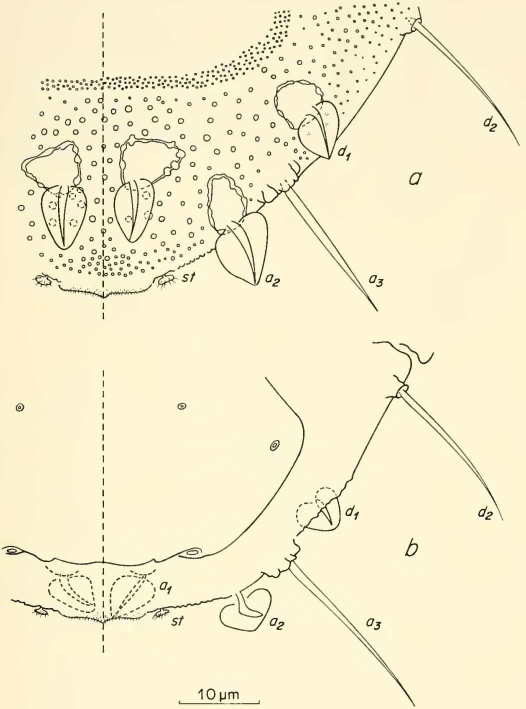

FIG. 1.

Gravieripus cordatus, first instar larva.

a, pygidial tergum, dorsal view.

b, pygidium, ventral view (anal plate and setae of pygidial sternum not drawn).

The a_1 and a_2 as in preceding stage, a_3 and d_2 also similar but shorter. Distance a_1-a_1 1.4-1.7 times as long a_1, distance a_1-a_2 1.9-2.3 times as long as distance a_2-a_3.

3.3. THIRD INSTAR LARVA (fig. 3)

It has 6 pairs of legs, 5 tergites and 4 pairs of tactile setae; length 0.47-0.65 mm, breadth 0.30-0.33 mm.

Pygidial tergum. Posterior margin as in preceding instar larvae. There are 4 pairs of setae: *st*, a_1, a_2 and a_3. Neither d_1 nor d_2. Relative length of setae: a_1 = 10, a_2 = 11-15, a_3 = 19-25.

The number of the setae is the same as in the adult animal and their shape is also similar to the one in that stage (fig. 5). However, the a_1 are proportionately thicker and

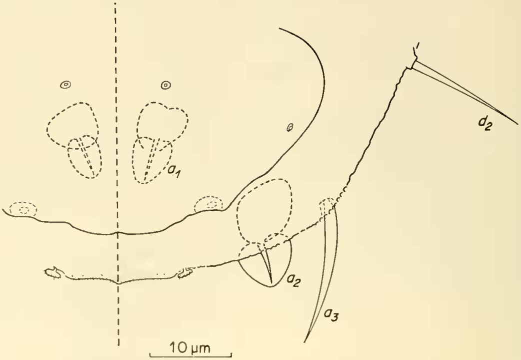

FIG. 2.

Gravieripus cordatus, second instar larva.
Pygidium, ventral view.

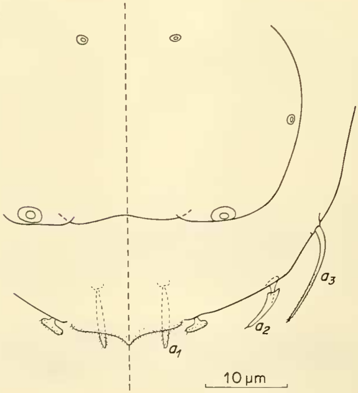

FIG. 3.

Gravieripus cordatus, third instar larva.
Pygidium, ventral view.

the a_2 are more pointed and sometimes also with vestiges of wings in the proximal half. Distance a_1-a_1 1.3-1.7 times as long as a_1, distance a_1-a_2 1.1-1.6 times as long as distance a_2-a_3. The a_1 is on the dorsal side of the tergum, the a_2 and a_3 on its posterior margin.

3.4. FOURTH INSTAR LARVA (fig. 4)

It has 8 pairs of legs, 5 tergites and 4 pairs of tactile setae; length 0.57-0.92 mm, breadth 0.39-0.41 mm.

Pygidial tergum. Posterior margin as in preceding instar larvae. There are 5 pairs of setae: *st*, a_1, a_2, a_3 and d_2. No d_1. Relative length of setae: $a_1 = 10$, $a_2 = 12\text{-}15$, $a_3 = 21\text{-}30$, $d_2 = 21\text{-}31$.

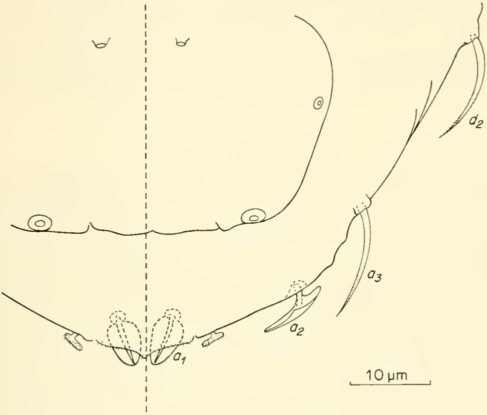

FIG. 4.

Gravieripus cordatus, fourth instar larva.
Pygidium, ventral view (a_2 lateral view).

The number, arrangement and general shape of the setae as in the second instar larva but the a_1 are inserted nearer the posterior margin of the tergum and their wings are narrower. The d_2 are not straight but curved inwards, often also with a short distal pubescence. Distance a_1-a_1 as long as to 1.5 times as long as a_1, distance a_1-a_2 1.1-1.5 times as long as distance a_2-a_3.

3.5. ADULT (fig. 5)

It has 9 pairs of legs, 6 tergites and 5 pairs of tactile setae; length 0.73-0.98 mm, breadth 0.43-0.45 mm.

Pygidial tergum. Posterior margin as in preceding instar larvae but coarser between *st* and a_2. There are 4 pairs of setae: *st*, a_1, a_2 and a_3. Neither d_1 nor d_2. Relative length of setae: $a_1 = 10$, $a_2 = 8\text{-}10$, $a_3 = 14\text{-}17$.

The number, arrangement and general shape of the setae are as in the third instar larva. The a_1 are thin, cylindrical, blunt, slightly S-bent and a little diverging; a_2 are thicker, also cylindrical and blunt, converging; a_3 spinous, bent inwards; a_1 are glabrous or faintly pubescent, a_2 pubescent on outer side of distal half. Distance a_1-a_1 0.8-0.9 of length of a_1; distance a_1-a_2 1.2 times as long as distance a_2-a_3.

The pygidial characters of the adult Greek specimens agree well with the type specimens from Spain and Turkey. However, the distal appendages of the anal plate are not hearth-shaped but broadly lanceolate and their length in proportion to the length of the plate is greater.

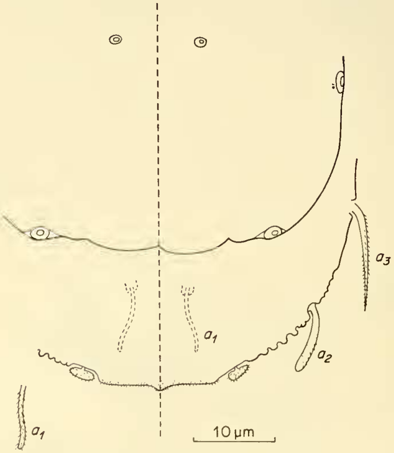

FIG. 5.

Gravieripus cordatus, adult. — Pygidium, ventral view.

One may, of course, make the objection that the aberrant first, second and fourth instar specimens described above were not *Gravieripus cordatus* but a new species occurring with it. However, other characters than those of the pygidial tergum show that they belong to the former. Moreover, because representants of *Gravieripus* are very rare it seems unlikely that two different species of the genus, one of them also new, should have been collected together in three places far away from each other.

4. RESULTS

In the above account the chaetotaxy of the pygidial tergum in the post-embryonic stages of *Gravieripis cordatus* has been described. Contrary to other Pauropoda whose development has been examined this species has three stages with some setae strongly differing in shape from the corresponding setae in the remaining stages. In the first, second and fourth instar larvae the setae a_1, a_2 and a_3 do not have the simple shape observed in the two other stages but have all two transparent wings, by that means resembling shields. In the third instar larva these setae have the same general shape as in the adult animal.

Moreover, in the first, second and fourth instar larvae there are setae on the antero-lateral parts of the tergum which seem to correspond to the setae d described in some stages in various Pauropoda. The first instar larva has both the d_1 and d_2, the former winged and the latter straight and pointed but the second and fouth instar larvae have only the d_2. In the third instar larva and the adult there is neither d_1 nor d_2.

The occurrence of the setae d in immature eurypauropodids has earlier been stated by Remy (1937: 31 and 1954: 130). In the former he says that the pygidial tergum of the fourth instar larvae of *Gravieripus latzeli* (Cook) have " mindestens ein Paar supplementärer Borsten " and in the latter he mentions such setae in a second instar larva of *Eurypauropus sp.* from Michigan: "il y a ... des soies d_2 mais je n'ai pu apercevoir de d_1". Though these observations were not made in the species studied here they are consistent with those accounted for.

Though the avilable material now is too meagre it seems as if there might be a similar change in the post-embryonic chaetotaxy of the pygidial tergum in *Trachypauropus glomerioides* Tömösvàry.

5. CONCLUSIONS

As a principle it is not unexpected to find in an Arthropoda group developmental stages having characters strongly diverging from those in the adults but it is hitherto without parallel in the Pauropoda. So the occurrence of a different chaetotaxy in the first, second and fourth instar larvae on one hand and the third instar larva and the adult on the other is interesting. Pygidial characters such as shape, arrangement and length of the setae have always been accounted distinctive but here they have to be excluded from the diagnostic characters. A single find of a *Gravieripus cordatus* specimen with 3, 5 or 8 pairs of legs could have resulted in a description of an invalid species.

It is evident that the supposed high stability in the postembryonic development of the pygidial characters in the Pauropoda, at least in Eurypauropodidae, might be less than has earlier been regarded and have to be considered in future taxonomical studies.

Zusammenfassung

Die Chaetotaxie des pygidialen Tergums in den postembryonalen Stadien der Eurypauropodiden-Art *Gravieripus cordatus* wird beschrieben. Die ersten, zweiten und vierten Stadien der Larven sind unter sich ähnlich und stark abweichend von dem dritten Larvenstadium und den erwachsenen Exemplaren. Diese Beobachtung ist erstmalig bei den Pauropoden und zeigt, dass die angenommene hohe Stabilität des pygidialen Characters während der postembryonalen Entwicklung geringer ist als früher vermutet wurde, auf jeden Fall bei den Eurypauropodiden.

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